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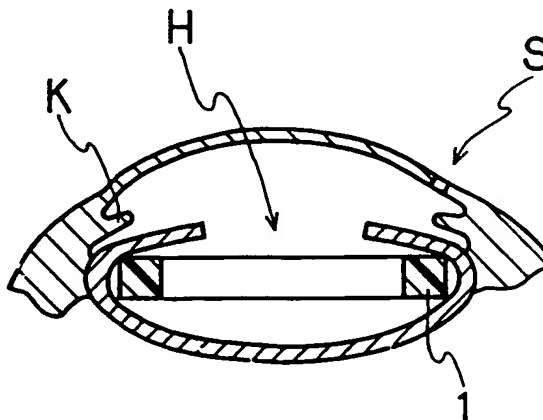
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Device for inhibiting aftercataract.

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A device for inhibiting aftercataract being made of a material having a resilient property and having substantially circular shape so as to be internally touched to an equator of a capsular bag along a whole of an outer periphery thereof.

FIG. 10



EP 0 507 292 A1

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The present invention relates to a device for inhibiting aftercataract (hereinafter referred to as an inhibiting device) and more particularly to an inhibiting device for keeping a shape of a capsular bag substantially circular after a cataract extraction and for inhibiting such as invasion metamorphosed epithelial cells into a posterior capsular bag, and further to an inhibiting device wherein an intraocular lens can be retained in good state by forming a groove in an inner periphery thereof.

As an operation method of cataract, the method, wherein an anterior capsular bag is provided with an opening and a crystalline lens is removed through the opening, has hitherto been employed. A refraction of an eye is rectified by inserting an intraocular lens into the capsular bag instead of the removed crystalline lens, wearing a contact lens on a cornea, or wearing a pair of spectacles.

When the intraocular lens is used, such an intraocular lens 51 as shown in Fig. 18 has hitherto been used. The intraocular lens is composed of a lens 52 and two support members 53 having a wire like shape. The support member 53, wherein one end is fixed to the lens 52 and another end (outer side) is bended in such a manner as to extend along an equator of the capsular bag and contact with the equator, keeps the equator of the capsular bag circular. However, it is difficult that the above mentioned support member 53 keeps the equator of the capsular bag circular due to the shape thereof, and there is such a danger that the support member adds an uneven force by partially contacting with the equator. Therefore, after inserting the intraocular lens into the capsular bag, the intraocular lens in the capsular bag becomes unstable after a long interval. Then, deviation or falling down sometimes happens.

The intraocular lenses 54, 55 shown in Figs. 19 to 20 are proposed (with reference to Japanese Unexamined Patent Publication No. 285258/1989 and Japanese Unexamined Patent Publication No. 503525/1990). Each of the above lenses is composed of a lens portion 56, 57 and a support member 58, 59 which encloses the outer periphery of the lens portion having a circular loop like shape. The equator of the capsular bag can be kept to be circular in more preferable state compared with the intraocular lens of Fig. 18. It is difficult to insert the circular support member into the capsular bag through the incised opening as the original shape thereof. Therefore, the intraocular lens is inserted into the capsular bag by deflecting the support member to have an oval shape (referring to Fig. 19) or shrinking the support member in such a manner that circular shape thereof is kept (referring to Fig. 20).

The capsular bag after a cataract extraction sometimes happens to produce opacity by prolif-

eration and denaturation of epithelial cells or metaplasia of partial epithelial cells residual in the equator of the capsular bag if the capsular bag is left as it is. This phenomenon is generally called an aftercataract. The secondary operation, dilaceratio, is need to be performed. As mentioned hereinbefore, when the intraocular lens is inserted into the capsular bag and the intraocular lens is fixed therein after the cataract extraction, there is such an intraocular lens as to inhibit the aftercataract to a certain extent by keeping the shape of the capsular bag and sealing the residual epithelial cell in the equator by virtue of the shape of the support member of the intraocular lens. However, the support member is not coming into contact with the whole part of the equator. Therefore, aftercataract is not completely inhibited.

Further, when the capsular bag which is left as it is for a long time not inserting the intraocular lens, that is, the eyesight is rectified in such a manner that the contact lens is wore or the pair of spectacles is wore, the capsular bag, wherein cataract extraction is performed, aftercataract and the like is often produced. When the capsular bag is removed, such a complication that the vitreous body located in the back side of the eye goes forward is apt to come out. Accordingly, the capsular bag is not removed even if the intraocular lens is not inserted into the capsular bag.

The object of the present invention is to resolve the problems mentioned hereinbefore and provide an inhibiting device wherein aftercataract is inhibited from coming out and the circular shape of the equator can be kept stably.

A device for inhibiting aftercataract of the present invention is made of a material having a resilient property and has substantially circular shape so as to be internally touched to an equator of a capsular bag along a whole of an outer periphery thereof.

It is preferable that the device has at least two protrusion portion touched internally to a whole of an outer periphery thereof.

Further, it is preferable that the device is provided with a groove for engaging with a support member of an intraocular lens extending in the circumferential direction in an inner periphery of the device in order to retain the intraocular lens.

In this case, it is preferable that the groove is formed in the whole of the inner periphery of the device.

Further, it is preferable that in the groove comprising a front wall portion and a back wall portion, the back wall portion wherein a protrusion circumferentially formed in the inner periphery of the device extends in the radial direction in such a manner that the back wall portion is directed toward the center of the device, is more inner than

the front wall portion, and said back wall portion being beveled in such a manner that a width in the axial direction (or the width wise direction) of the device is widened as the back wall portion is away from the center of the device.

The meanings of "substantially has a circular shape" mentioned in Claims is a concept including not only a complete round but also a polygonal shape so that the outer periphery of the device can be internally touched to the whole of the equator of the capsular bag. The meanings of "a front wall portion" is one of side walls located in the front side of the device when the device is worn in the eye and the meanings of "a back wall portion" is the other side wall located in the back side of the capsular bag of the eye.

The inhibiting device of the present invention is easily deformed in accordance with the desired shape by pinching the device slightly by means of a pincette and the like. Therefore, particular technique for inserting is not required and the device is easily inserted into the capsular bag through even a small incised opening by means of Continuous Circular Capsulorhexis (CCC) method. After inserting the device into the capsular bag, the device returns to the circular shape, which is an original shape, by means of the resilient property of the device. Accordingly, the outer periphery of the device is innerly touched to the whole of the equator and the epithelial cells which are residual within the portion between the equator and the outer periphery of the device, so that proliferation of the residual epithelial cells can be inhibited in good condition. On the other hand, the equator of the capsular bag can be kept to be almost circular. Therefore, the capsular bag is given to a tensility so that the capsular bag is effectively inhibited from shrinking. Thus, the produce of the aftercataract can be inhibited by the effect of the device.

Further, the shape of the incised opening is kept and the intraocular lens can be easily inserted into the capsular bag by the tension of the capsular bag. In this case, when the inhibiting device having a groove in the inner periphery thereof is used, the support portion of the intraocular lens inserted into the capsular bag is engaged with the groove formed in the inner periphery of the inhibiting device and fixed thereto. As a result, the intraocular lens is inhibited from falling down or deviation.

Fig. 1 is a partially cutaway perspective view showing an embodiment of an inhibiting device of the present invention;

Fig. 2 is a partially schematic sectional view taken along lines II-II in Fig. 1;

Fig. 3 is a partially schematic sectional view showing another embodiment of the inhibiting device of the present invention;

Fig. 4 is a partially cutaway sectional view show-

ing another embodiment of the inhibiting device of the present invention;

Fig. 5 is a partially schematic sectional view taken along lines V-V in fig. 4;

Fig. 6 is a partially schematic sectional view showing another embodiment of the inhibiting device of the present invention;

Fig. 7 is an explaining view showing a use of the inhibiting device of Fig. 1;

Fig. 8 is an explaining view showing a use of the inhibiting device of Fig. 1;

Fig. 9 is an explaining view showing a use of the inhibiting device of Fig. 1;

Fig. 10 is an explaining view showing a use of the inhibiting device of Fig. 1;

Fig. 11 is an explaining view showing a use of the inhibiting device of Fig. 4;

Fig. 12 is an explaining view showing a use of the inhibiting device of Fig. 4;

Fig. 13 is an explaining view showing a use of the inhibiting device of Fig. 4;

Fig. 14 is a partially schematic sectional view showing another embodiment of the inhibiting device of the present invention;

Fig. 15 is an explaining view showing a use of the inhibiting device of Fig. 14;

Fig. 16 is a perspective view showing another embodiments of the inhibiting device of the present invention;

Fig. 17 is an explaining view showing a use of the inhibiting device of Fig. 16;

Fig. 18 is a plan view showing an example of a conventional intraocular lens;

Fig. 19 is a plan view showing another example of a conventional intraocular lens; and

Fig. 20 is a plan view showing another example of a conventional intraocular lens.

In Fig. 1, numeral 1 denotes an inhibiting device wherein an outer diameter is about 10 mm, an inner diameter is about 8 mm and each of width (W in Fig. 2) and thickness (T in Fig. 2) is respectively about 1 mm. Those sizes are values which are determined by a normal size of the capsular bag. Accordingly, the outer diameter and the thickness are not limited to the above size. For instance, with respect to the outer diameter, a range of 8 to 12 mm is general and with respect to the thickness, a range of 0.4 to 2.0 mm is general. Further, there is such a case as to be beside the above range in accordance with the material which forms the inhibiting device. A shape in section of a base wire portion of the inhibiting device is substantially square wherein a length of each side is about 1 mm as shown in Fig. 2. In the present invention, any shape in section of the outer periphery of the inhibiting device 1 can be employed, wherein the residual epithelial cells can be sealed in the equator in good state. The shape in section is not

limited to a square shape; such a shape as shown in Fig. 3 can be employed.

In the inhibiting device 1 having a square shape in section as shown in Fig. 2, corner portions 1a wherein protrusions are formed in the whole of the outer periphery are coming into substantially line contact with the capsular bag. Accordingly, the residual epithelial cells can be sealed in the equator of the capsular bag in good state and the capsular bag can be prevented from producing an aftercataract caused by a proliferation or denaturation of the residual epithelial cells or by a mataplasia of a part of the residual epithelial cells. Then, the aftercataract which becomes a problem after removing the crystalline lens can be effectively inhibited. The inhibiting device 2 shown in Fig. 3 has also the corner portion 2a wherein the protrusions are formed in the whole of the outer periphery. Therefore, the protrusions of the corner portion 2a cause the same effect that the protrusions 1a cause. The inhibiting device 2 has a shape wherein the outer periphery has a recess which is grooved centripetally between the corner portions 2a. Therefore, when the eye is inserted by the inhibiting device 2 as mentioned hereinafter, the inhibiting device can be easily bended by engaging a pincette and the like with the recess.

On the other hand, in Figs. 4 to 6 the inhibiting devices 3, 4, wherein a groove 5 for retaining a support portion of an intraocular lens is formed in the whole of the inner periphery, are shown. The width W of the groove 5 shown in Fig. 5 is about 0.5 mm and the depth T of the groove 5 is about 0.5 mm. The size of the groove 5 is also determined by the size of the support portion. Accordingly, in the inhibiting device of the present invention, the size of the groove is not limited to the above value. Further, in the present invention, the groove is not necessarily limited in such a manner that the groove is formed in the whole of the outer periphery, such a shape that the groove is partially or intermittently formed can be employed in accordance with the shape of the support portion of the intraocular lens which is engaged with the inhibiting device. However, the groove 5 which is formed in the whole of the outer periphery is preferably employed in order to cope with all kinds of the intraocular lens and all kinds of the method for inserting the intraocular lens.

According to the conventional intraocular lens 54, 55 (referring to Figs. 19 to 20), even if the intraocular lens is made to be such a means as to be easily inserted into the capsular bag, when the intraocular lens 54 shown in Fig. 19 is inserted into the capsular bag, the support portion of the intraocular lens is permitted to become an oval like shape (shown with two-dot chain line in Fig. 19) so that a major axis of the oval is still longer than an

inner diameter (about 10 mm in a normal case) the capsular bag. Accordingly, the intraocular lens 54 is difficult to be inserted into the capsular bag so that the intraocular lens has no practical use. On the other hand, with respect to the intraocular lens 55 shown in Fig. 20, such a particular technique of inserting the intraocular lens into the capsular bag has been required that the intraocular lens is shrunk (i.e. diameter of the intraocular lens is shortened) by winding the support portion 59 along the periphery of the lens portion 57 and the above state of the intraocular lens is kept. Further, the incised opening for inserting the intraocular lens into the capsular bag tends to be small for fear that the eye is damaged. Therefore, it is still more difficult to be inserted.

The inhibiting device of the embodiment of the present invention can resolve the above problems. That is to say, a stably fixed state is ensured by engaging the support portion of the intraocular lens with the groove 5 formed in the inner periphery of the inhibiting device 3, 4 as mentioned hereinbefore.

In the inhibiting device 3 shown in Figs. 4 to 5, the shape in section of the base wire is substantially circular shape wherein the diameter is about 1 mm. The shape in section is not limited to the circular shape in the present invention. The inhibiting device wherein the shape in section is square as shown in Fig. 6 can be employed.

If the equator is closely contacted with the inhibiting device so that there is not any space to produce the residual epithelial cells in the equator of the capsular bag, the aftercataract can be inhibited in spite of the circular shape in section of the inhibiting device.

When the shape in section is circular, the contacting surface wherein the outer periphery of the inhibiting device 3 is coming into contact with the inner wall of the capsular bag is wide. Therefore, stress concentration can be effectively avoided. On the other hand, in the inhibiting device 4 wherein the shape in section is square as shown in Fig. 6, the corner portions 3a located in the outer periphery is coming into substantially line contact with the capsular bag. Therefore, the residual epithelial cells can be sealed in the equator of the capsular bag as mentioned hereinbefore, and the effect, wherein aftercataract coming to a postoperative problem is inhibited, is superior.

As a material of the inhibiting devices 1 to 4, and the inhibiting devices 11 and 12 of the embodiment mentioned hereinafter, the material which has a resilient property in order to insert the inhibiting device into the capsular bag and stably fix therein, is selected. In the embodiment, silicone rubber is employed as the material. If the material is suitable for ophthalmics (for instance, if the material has a

suitability in vivo, a stability of the shape and the like), the material is not limited in the present invention, for instance high polymers having water absorption property comprising hydroxyethylmethacrylate, N-vinylpyrrolidone, vinyl alcohol and the like, a biopolymer comprising collagen and the like, and an elastomer silicone rubber, acrylic rubber and the like and a mixture or copolymer of these materials can be employed.

Further, such a synthetic resin having an inferior clarity as to be normally used as a medical material such as polyethylene, polypropylene vinyl chloride, polyvinylidene fluoride and the like can be employed, and even a hard synthetic resin such as polymethylmethacrylate can be employed as the material of the inhibiting device if the resilient property is given by suitably selecting the shape or thickness.

The inhibiting devices 1 to 4 of the above-mentioned embodiment and the inhibiting devices 11 and 12 of the embodiment mentioned hereinafter, which are constructed by a single material in consideration of an easiness of manufacturing in such a manner as to be integrated, can be easily manufactured by means of molding.

Next, it will be explained with reference to Figs. 7 to 13 how to use the inhibiting device constructed as mentioned hereinbefore. In Figs. 7 to 13, character K denotes a mydriatic iris, character H denotes an incised opening located in the anterior capsular bag, character S denotes an incised opening located in a sclera, character P denotes a pincette. Firstly, a cataractous crystalline lens is removed through the incised opening H and the incised opening S and viscomaterial is fully injected into the capsular bag. Then, the inhibiting device is pinched by the pincette so that the shape thereof becomes almost oval. Next, the deformed inhibiting device is inserted into the capsular bag through the incised openings S and H (referring to Figs. 7 and 9). In order to insert the inhibiting device 1 into the capsular bag, a tool other than the pincette such as a commercial injector for soft IOL (intraocular lens) can be employed. When the inhibiting device is inserted into the capsular bag, the inhibiting device 1 restores the original circular shape by means of the resilient property. Accordingly, the inhibiting device is internally touched to the whole of the equator of the capsular bag (referring to Fig. 8 and 10). Thereby, the residual epithelial cells in the equator are sealed therein. Further the capsular bag is given a tension. Therefore, a shrinkage of the capsular bag is effectively inhibited and aftercataract can be inhibited.

Further, the equator is kept to be circular and the incised openings S and H maintain the shape (referring to Figs. 8 and 10). Therefore, the intraocular lens, which is generally used, can be

easily inserted into the capsular bag through the incised openings S and H. In this case, if the inhibiting device 3, 4 having a groove is employed, (referring to Fig. 11), it does not happen that the intraocular lens deviates or falls down since the support portion of the intraocular lens is engaged with the groove of the inhibiting device so that intraocular lens is stably fixed (referring to Figs. 12 and 13).

In Fig. 14, the other embodiment of the inhibiting device which has a groove in the inner periphery is shown.

The inhibiting device 11 is an example of variation of the inhibiting device 4 having a square shape in section shown in Fig. 6 which has such a construction that a groove 12 comprising a front wall 14 and a back wall 13 is formed in the whole of the inner periphery of the inhibiting device, the back wall 13 wherein a protrusion which is circumferentially formed in the inner periphery of the inhibiting device extends in a radial direction in such a manner that the back wall 13 is directed to a center of the inhibiting device, being still more inner than the front wall 14, and the back wall 13 being beveled in such a manner that a width of the groove 12 is widened as the back wall 13 is away from the center.

The back wall can be constructed in such a manner that the back wall has a circular shape which is almost concentric to the outline (circular shape) of the inhibiting device when the inhibiting device is viewed from upper side. Such a construction can be also employed that the portion, wherein the support portion of the intraocular lens is contained, is centripetally protruded. In short, such a shape can be employed that an optical portion of the intraocular lens to be inserted is secured, the support portion of the intraocular lens can be easily engaged with the groove of the inhibiting device and easily deformed when the inhibiting device is inserted into the capsular bag. For instance, the inner diameter of the back wall, wherein the above circular hole is formed, is preferably 5 to 7.5 mm in accordance with the object of the present invention.

In the present invention, the inhibiting device is not limited to the device wherein the shape in section is square (Fig. 14). The inhibiting device 3 of Figs. 4 to 5 having a circular shape in section, wherein the back wall is protruded, can be employed.

It will be explained with reference to Fig. 15 as follows how to use the inhibiting device 11. Firstly, the inhibiting device 11 is inserted into the capsular bag. The inserting method is the same as mentioned hereinbefore. Secondly, the intraocular lens 4 is inserted into the capsular bag. At this time, the support member of the intraocular lens is contacted with a slanting surface of the back wall 13. Then

the support member moves along the slanting surface due to a restoring force thereof and extends to the groove 12 so that the support member is completely contained in the groove 12. In other word, the back wall 13 which is centripetally protruded plays such a part, as to guide the support member of the intraocular lens 6 so that the intraocular lens can be easily and surely inserted and fixed. Since the back wall 13 is centripetally protruded, an ophthalmologist who performs an operation can not only confirm the back wall 13 of the inhibiting device which is inserted into an eye and set but also insert and fix the intraocular lens easily and surely.

In Fig. 16, another embodiment of the inhibiting device which does not have the groove.

The inhibiting device 21 is an example of a variation of the inhibiting device 1 shown in Fig. 1. The inhibiting device has such a construction that one end 21a of the inhibiting device is inserted into a groove 21c which is formed from the other end 21b.

Thus constructed inhibiting device 21 can shorten the outer diameter thereof in such a manner that one end 21a is inserted into the groove 21c from the other end 21b. Therefore, the inhibiting device can be still more easily inserted into the eye. By inserting the inhibiting device into the capsular bag, the inhibiting device is completely inscribed in the equator of the capsular bag, the residual epithelial cells in the equator of the capsular bag can be sealed in the equator and cataract caused by proliferation of cells can be effectively inhibited. Further, since the inhibiting device can keep the shape of the capsular bag circular, shrinkage of the capsular bag is inhibited and aftercataract can be effectively inhibited.

On the other hand, since the device can keep the shape of the capsular bag circular, the shape of the incised opening is kept in good state. Therefore, when the intraocular lens is inserted after the crystalline lens is removed, the intraocular lens can be easily inserted and it does not happen that the intraocular lens damages the incised opening by adding unstable force. In this case, the intraocular lens can be firmly retained and inhibited from falling down and moving, then can be fixed in good state by using an inhibiting device having a groove.

Though several embodiments of the present invention are described above, it is to be understood that the present invention is not limited only to the above-mentioned, and various changes and modifications may be made in the invention without departing from the spirit and scope thereof.

## Claims

1. A device for inhibiting aftercataract being made

of a material having a resilient property and having substantially circular shape so as to be internally touched to an equator of a capsular bag along a whole of an outer periphery thereof.

2. A device for inhibiting aftercataract of Claim 1 which has at least two protrusion portion touched internally to a whole of the equator of the capsular bag along a whole of the outer periphery thereof.

3. A device for inhibiting aftercataract of Claim 1 which is provided with a groove for engaging with a support member of an intraocular lens extending in the circumferential direction in an inner periphery of the device in order to retain the intraocular lens.

4. A device for inhibiting aftercataract of Claim 3 wherein said groove is formed in the whole of the inner periphery of the device.

5. A device for inhibiting aftercataract of Claim 4 wherein in said groove comprising a front wall portion and a back wall portion, said back wall portion wherein a protrusion circumferentially formed in the inner periphery of the device extends in a radial direction in such a manner that said back wall portion is directed toward a center of the device, is still more inner than the front wall portion.

6. A device for inhibiting aftercataract of Claim 5 said back wall portion being beveled in such a manner that a width in the axial direction of the device is widened as the back wall portion is away from the center of the device.

FIG. 1

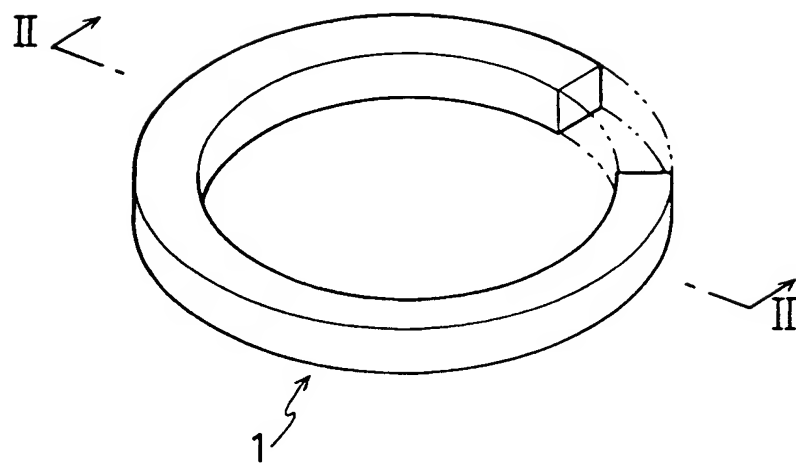


FIG. 2

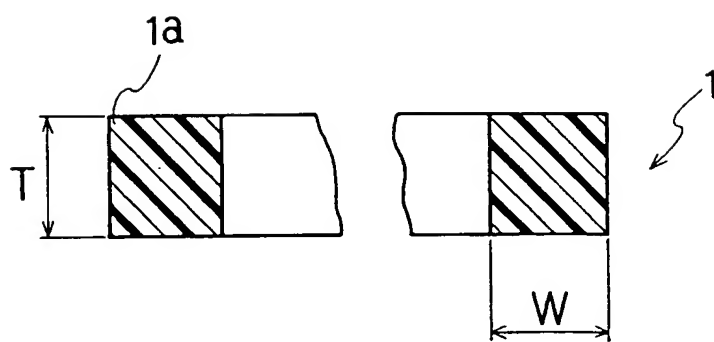


FIG. 3

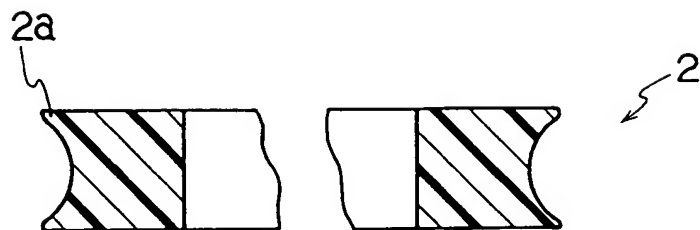




FIG. 4

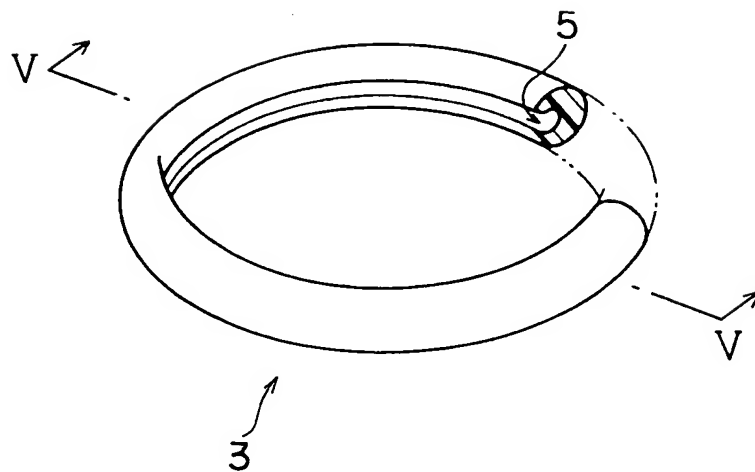


FIG. 5

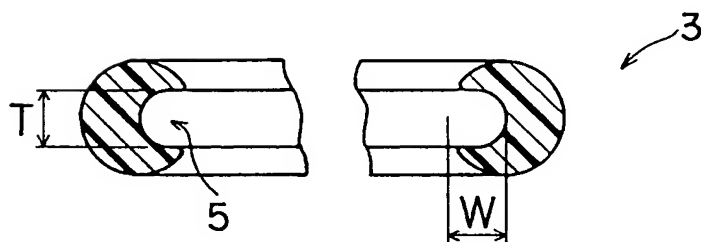


FIG. 6

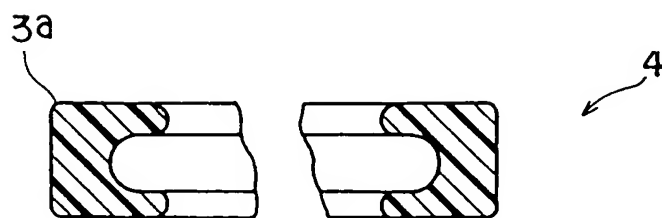


FIG. 7

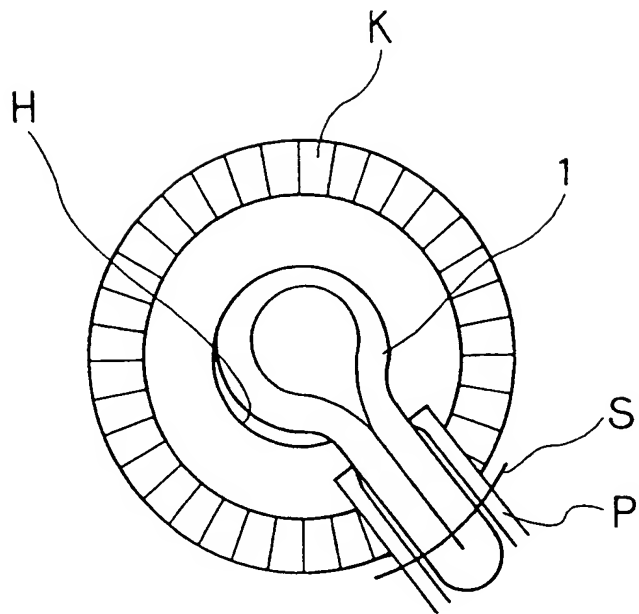


FIG. 8

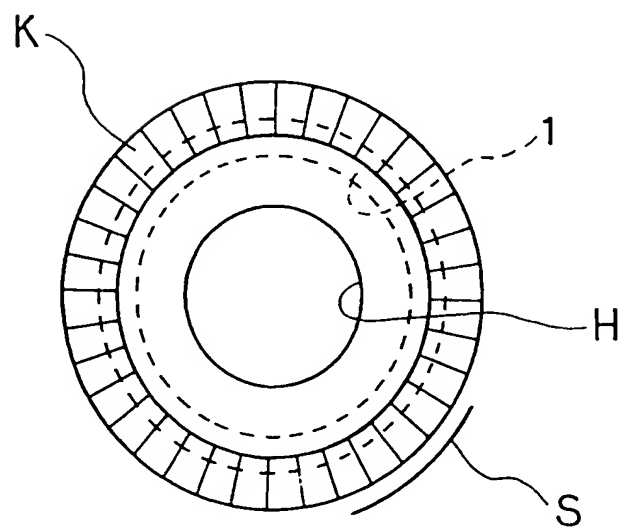


FIG. 9

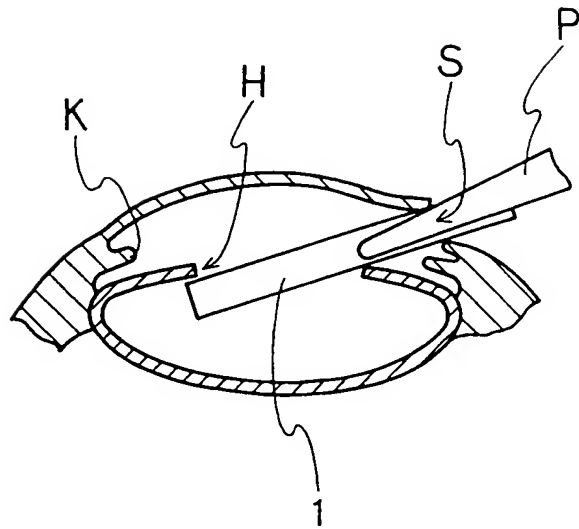


FIG. 10

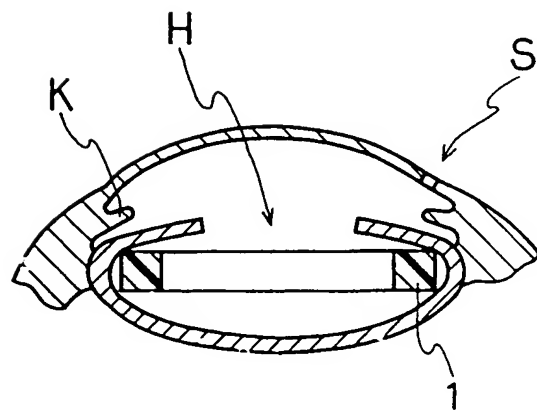


FIG. 11

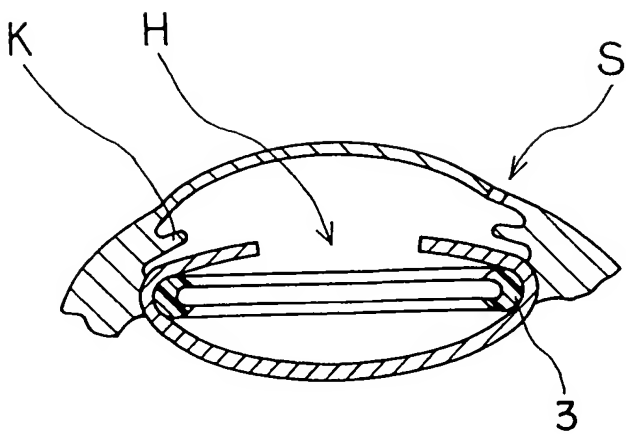


FIG. 12

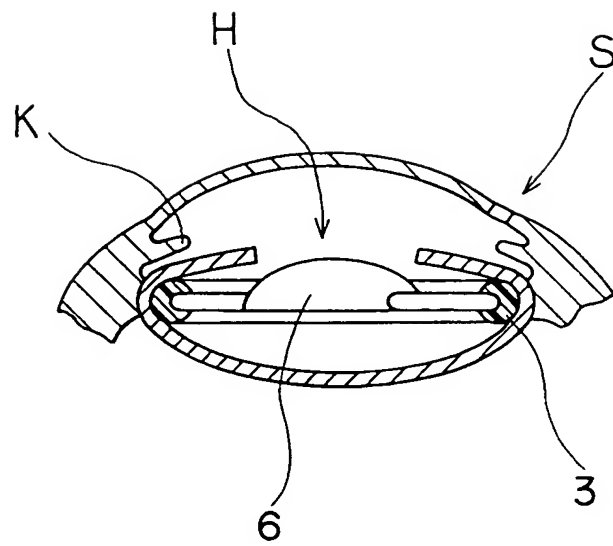


FIG. 13

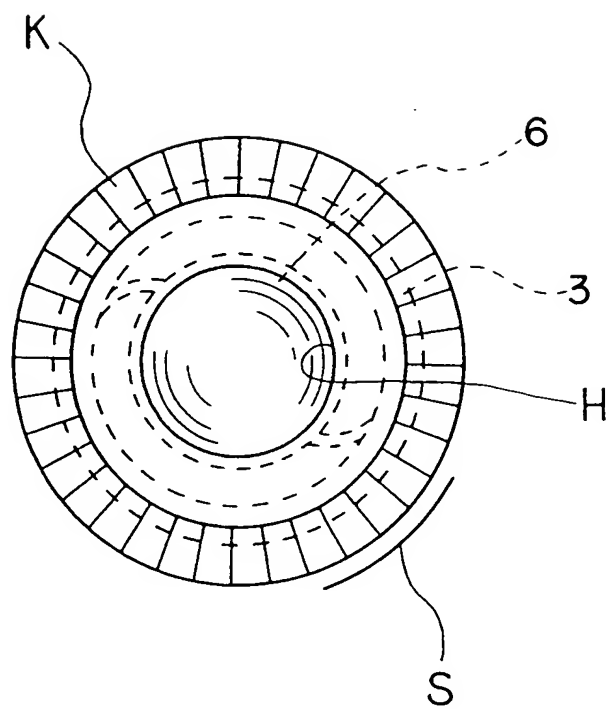


FIG. 14

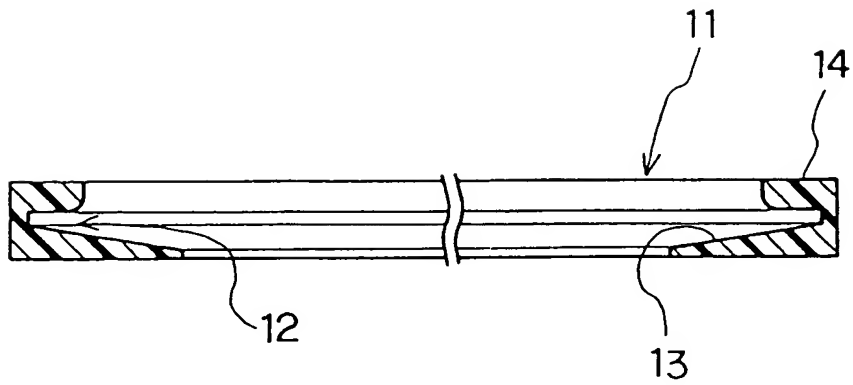


FIG. 15

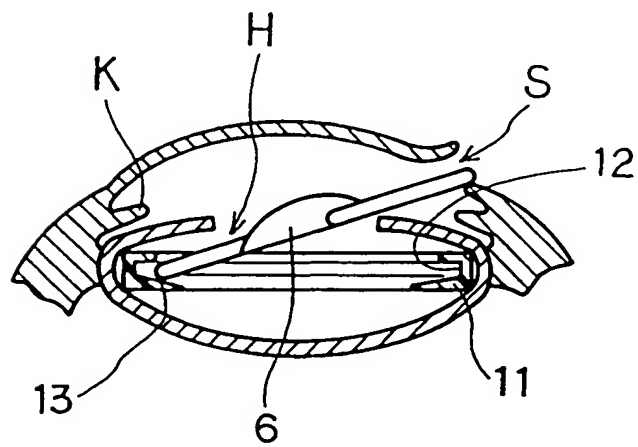


FIG. 16

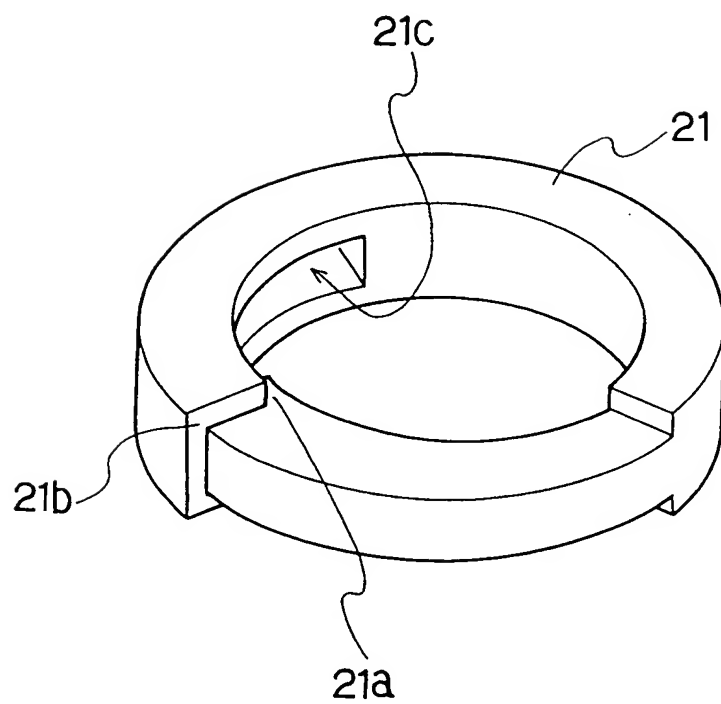




FIG. 17

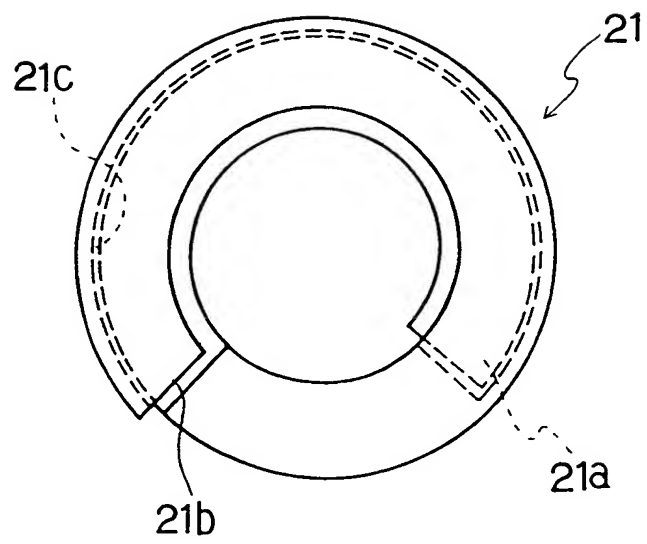


FIG. 18

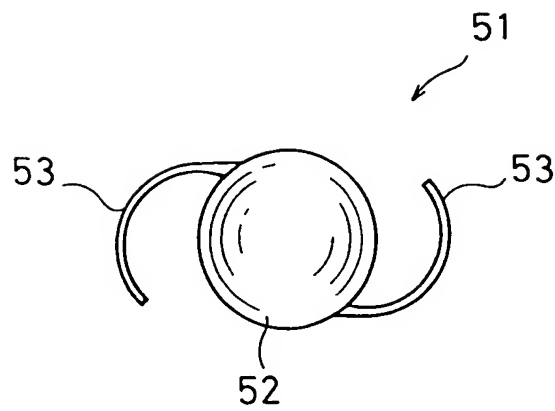


FIG. 19

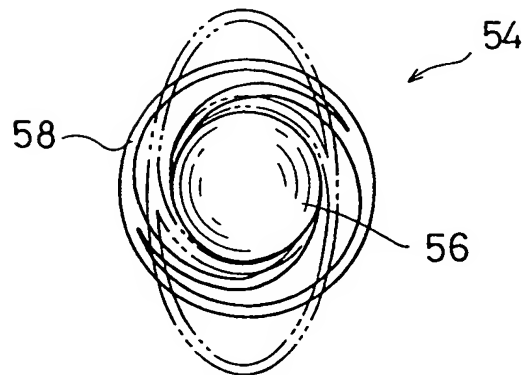
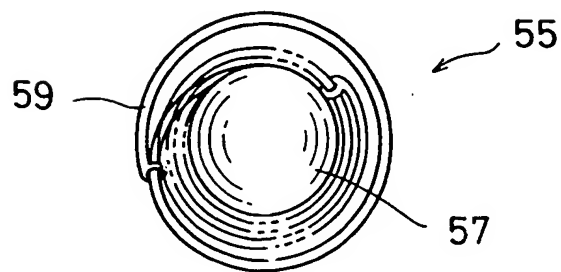


FIG. 20





European Patent  
Office

## EUROPEAN SEARCH REPORT

Application Number

EP 92 10 5656

| DOCUMENTS CONSIDERED TO BE RELEVANT   |  |  |   |
|---|--|--|---|
| Category  | Citation of document with indication, where appropriate, of relevant passages  | Relevant to claim                                | CLASSIFICATION OF THE APPLICATION (Int. CL.5) |
| X   | WO-A-8 907 426 (LANGERMAN)<br>* page 9, line 3 - page 11, line 6 *<br>* page 21, line 14 - page 25, line 5; figures 1-14 * | 1,3-5  | A61F2/16<br>A61F2/14                          |
| X   | US-A-4 764 169 (GRENDahl)<br>* the whole document *  | 1,3,4  |   |
| X   | US-A-4 946 469 (SARFARAZI)<br>* column 2, line 57 - column 3, line 56; figures *   | 1  |   |
| A   | FR-A-2 530 457 (MAZZOCCO)<br>* figures 1-7 *   | 1  |   |
| A   | WO-A-8 900 032 (CALDWELL ET AL)  |  |   |
|   |  |  | TECHNICAL FIELDS SEARCHED (Int. CL.5)         |
|   |  |  | A61F  |
| The present search report has been drawn up for all claims  |  |  |   |
| Place of search<br>THE HAGUE  |  | Date of completion of the search<br>01 JUNE 1992 | Examiner<br>SANCHEZ Y SANCHEZ J.              |
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